

100# P-289



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 24, 1987

In reply refer to: P-87-29 through -33

Mr. David Biegler
President
Lone Star Gas Company
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On March 12, 1986, a contractor operating a backhoe in Forth Worth, Texas, snagged, lifted, and punctured a Lone Star Gas Company natural gas service line at 9:15 a.m. The gas service line supplied gas to an unoccupied building. Gas under 22 psi pressure escaped into the air and also leaked at a point 18 feet under the building where the service line had also been pulled apart at a girth weld.

The contractor notified the Lone Star Gas Company of the line puncture and a gas company crew and supervisor were dispatched to the scene. While the gas company crew was attempting to shut off the flow of gas to the punctured pipe, the unoccupied building exploded and burned at 10:09 a.m. Twenty-two persons were injured, the unoccupied building was destroyed, and 40 other buildings were damaged. Fifty-seven automobiles stored inside the destroyed building were damaged or destroyed. 1/

On February 20, 1986, using a copy of the gas company map for the area and information provided by the contractor about the proposed excavation, the line locator identified and marked across the path of the proposed excavation the 1 1/4-inch plastic gas service line located toward the east side of the building. The map showed the 1 1/4-inch line accurately. He also used a pipeline locator to verify the exact location of this line. He followed gas company procedures and did a thorough, accurate job of marking the 1 1/4-inch line where it crossed the proposed excavation toward the east side of the building.

The line locator placed an 18-inch mark at the south curb of East Lancaster Avenue over a 2 1/2-inch gas service line that ran from the 2-inch valve to the curb. He marked this line based on the indentations in the pavement and also, possibly, because of the indentation over the 2-inch gate valve. The 2 1/2-inch gas service line was not, however, shown on the map. Although the line locator spray-painted one 18-inch-long mark over the indentation, he did not paint any more marks beyond the square patch at the curb. This action suggests that the line locator may have assumed, because of the square patch, that the service line into the building had been cut and plugged at the curb and taken out of service. This possibility is corroborated by statements made by the contractor and city personnel that indicate that they understood from the line locator that the line probably was dead at the curb.

1/ For more detailed information, read Pipeline Accident Report—"Lone Star Gas Company Natural Gas Explosion and Fire, Fort Worth, Texas, March 12, 1986" (NTSB/PAR-87/03).

Although the pavement indentations indicated that work had been done beneath the surface of the asphalt, such indentations did not necessarily mean that the line had been cut and plugged. In addition, the line locator knew, based on his prior experience as a meter reader, that a line had at one time served the building. However, the map he was using did not show this line. Thus, the line locator had reason to question the existence and status of the line at the curb where the 18-inch line that he had spray-painted ended. However, he did not take any action to verify the line had been taken out of service.

The line locator could have called the dispatcher and requested that the billing records be checked to determine if the information on the map was correct. Based on the experience of the gas company supervisor who later responded to the accident, the line locator could have learned within a short time (as did the supervisor during the accident) that the gas service line was active and that a 2 1/2-inch line did in fact extend through the route of the proposed excavation.

The line locator also could have verified his assumption by trying to locate the 2 1/2-inch line with his pipeline locator as he did for the 1 1/4-inch plastic line. While the line locator said that he did not believe he could use his pipeline locator in that area because of interference from the buried electric line, he made no attempt to confirm this assumption. Based on information provided by the electric utility, there should have been no interference.

The line locator also could have had the contractor break through the pavement within the area of the proposed excavation. The line locator then could have used a probe bar or he could have had the contractor use hand tools to remove dirt from the area to determine if a gas line existed within the route of the proposed excavation.

While the line locator could have taken these actions to determine the existence and status of the line, he did not do so. Had gas company procedures adequately covered the actions he was expected to take to verify the existence and operational status of the line and had he been trained accordingly, it is likely that he would have marked the 2 1/2-inch line as thoroughly and accurately as he marked the 1 1/4-inch line. This action may have prevented the accident. Even though the line locator could have acted to verify the status of the line, he would not have had to rely on these other actions if the gas system map had shown the line.

The number one cause of pipeline accidents is excavation damage. Because their pipelines are located in the streets of the cities and towns where most excavation work is performed, gas distribution companies experience most of this type of damage. Therefore, gas distribution companies should be most concerned about accurately locating and marking their pipelines in areas of proposed excavations. Providing line locators with accurate maps showing the locations of all of the gas facilities, providing clear and concise procedures for locating buried pipelines, and properly training these employees must be an essential part of any gas company's program to prevent excavation damage.

When the three-man crew arrived at 9:40 a.m. to rectify the gas leak, the entire crew spent the first few minutes at the rupture site attempting to locate a means to shut off the flow of gas. When the supervisor arrived 5 minutes later, he realized that the gas service line might have pulled apart elsewhere and he was aware that gas could possibly migrate underground and into the building; however, he did not believe that sufficient gas was escaping to cause a problem. Furthermore, he did not take any positive

action to verify his assumptions, nor did he follow gas company emergency procedures for determining the extent of gas migration, or the need for personnel evacuation and ventilation. Both the supervisor and the crew leader emphasized that during this time, their main concern was to shut off the flow of gas at the valve. The four gas company employees dedicated themselves to this single effort to the exclusion of everything else.

During this time, however, some of the crew could have taken steps to confirm that the building was unoccupied and ventilated. The supervisor may have been told by one of the contractor's personnel that the building was vacant, but he did not verify this. He also assumed, without performing any tests, that most of the gas was venting from the visible point of rupture and that gas escaping beyond that point posed no immediate danger. Had he opened doors or windows of the building, breaking them if necessary, he probably would have smelled the gas or heard it escaping inside from the service line. Certainly, he would have been able to determine the presence of gas within the building had he used the available combustible gas indicator. Also, after confirming that the building was vacant, he could have ventilated the building using the doors, particularly the large garage-like doors and the two sets of double doors on the north side of the building, and he could have shut off the electricity or asked the power company to shut it off. Ventilating the building would have been the most important action to take to prevent or lessen the explosion. With the doors wide open and the prevailing 10- to 12-mph wind, the gas accumulation might never have reached an explosive level. Prompt arrival at accident sites with all efforts directed toward shutting off the flow of gas to the rupture is not enough; building evacuation and ventilation must also receive prompt attention.

When the dispatcher first received the contractor's telephone call informing him of the line break (service line rupture), he apparently believed it to be severe since he dispatched it as a grade 1 leak, meaning that it was to be treated as "an immediate and definite threat to the safety of persons or property." However, he did not notify the fire department. Gas company procedures do not provide specific guidance as to when the fire department should be notified, whether the dispatcher should have called the fire department upon initial notification of the leak (at 9:20 a.m.), or whether the dispatcher should have called after receiving the first report from the on-site gas company personnel (at 9:45 a.m.). Had the gas company dispatcher notified the fire department after he contacted the company crew, the fire department could have been on site within 5 minutes or about 40 minutes before the explosion. This would have allowed the firefighters, who are trained and equipped for responding to emergencies, to:

- (1) cordon off the area to exclude vehicles and pedestrian traffic;
- (2) check the building for people and determine the presence of gas by smell if not by instrument detection; and
- (3) ventilate the building and eliminate ignition sources.

Cordoning off the area would have kept persons on foot and in automobiles from being in front of the building when it exploded, thus reducing the number of injuries. Inspecting the building would have shown that it was not occupied and would have identified the location of any gas leakage and its seriousness (the broken 2 1/2-inch line inside the building). Ventilating the building with the large glass doors and windows might well have reduced the gas concentration below its combustible range. (The wind, which was 10 to 12 mph from the west, would have helped disperse this gas.) Finally, eliminating all sources of ignition might have prevented the explosion and fire.

If the crew leader had radioed the dispatcher after he arrived on site (9:40 a.m.), the fire department could have arrived by 9:50 a.m., about 19 minutes before the explosion. Although the amount of time available to perform the actions listed above would have been considerably shorter than if they had been notified by the dispatcher when he first learned of the leak (9:20 a.m.), the fire department still could have evacuated the area and ventilated the building. Whether ventilating the building would have prevented the explosion is not certain, but even if not, the explosion may have been much less powerful.

The Safety Board believes that the firefighters could have accomplished these tasks before the explosion if they had received immediate notification. They were trained for handling emergencies, they were aware of excavation and ventilation procedures, and they knew the importance of shutting off ignition sources when hazardous materials may be involved. The more lead time the fire department has, the better are its chances of safely mitigating the accident.

The gas company's written procedures for line marking and for emergency response were deficient in two critical areas related to this accident. The line location procedures did not provide specific guidance about actions to be taken if the line locator was unsure about the existence or status of a gas line or if he believed that the gas company map might be in error. The emergency response procedures also were unclear as to when, under what conditions, and by whom the local emergency response agencies are to be notified of grade 1 leaks. Management develops these procedures because it wants the procedures implemented in the field; however, as gas company employees demonstrated in this accident, written procedures must be comprehensive and clearly stated if management's expectations are to be accomplished.

However well-crafted, procedures cannot cover every facet of a gas distribution company's operations, maintenance, and emergency requirements for all possible situations. Knowledge gained through experience and periodic formal training also are essential if employees are to recall and comply with the procedures applicable to their assigned responsibilities. Periodic formal training provides the better means for management to convey what is expected of employees under varying circumstances and to determine through testing the level of an employee's comprehension of the procedures. Without such training and testing, management cannot expect employees to carry out the written procedures consistently and completely.

The supervisor previously had responded to hundreds of reports of gas leakage; however, he had never experienced one in which gas had escaped from piping beneath a structure. Furthermore, he had always been successful in shutting off the source of the leaking gas without an explosion or fire occurring. The supervisor's experience indicated that he had been successful in protecting public safety by following only one of the several emergency response actions called for in the written procedures. However, had the supervisor been trained to understand the purposes of the various actions spelled out in the written procedures and the importance of sequentially following the required actions, it is likely that the existing procedures would have been adequate to prevent the explosion.

In this light, it is interesting to note that the supervisor, less than 2 months before this accident, had conducted for his crew a "tailgate" safety session that touched on the emergency response procedures applicable to the events of this accident. Although the supervisor had never received formal training, he should have learned the procedures for handling such emergencies during his long experience with the gas company. However, he had never actually experienced such an emergency and this, combined with his lack of

formal training in these procedures, may have contributed to his failure to take the appropriate actions in this case. Further, his actions suggest that he may not have been adequately prepared to instruct others in handling such emergencies.

The gas company in 1982 implemented a formal training program of classroom and "hands on" training, which incorporated testing of employees to evaluate the level of their knowledge and ability in these procedures. However, neither the line locator nor the supervisor, both of whom had many years of service with the gas company, had ever received formal training in the procedures applicable to their responsibilities.

The gas company's training for employees hired before 1982 consists of work experience and nonevaluated readings of its procedures. Such training is based on activities that occur during daily work routines and provides little or no training in response to emergencies or other abnormal events. The Safety Board believes that such training has serious deficiencies since it is performed without specific learning objectives and without measurement to evaluate the accomplishment of these objectives. Thus, such training fails to deal with emergencies until one occurs. The failure of various gas company employees involved in this accident to take certain important actions suggest that they did not thoroughly understand the steps to be taken in emergencies of this kind. Proper training would have increased the likelihood that these employees would have made the appropriate response to this accident in accordance with the emergency procedures and the priorities established in them.

The Safety Board sees as constructive the gas company's development of formal training programs for its newly hired employees. However, equally important is the need to provide formal training for existing employees in following written procedures when responding to abnormal events and in accurately applying new or changed procedures.

Therefore, as a result of its investigation, the National Transportation Safety Board recommended that the Lone Star Gas Company:

Update and maintain system maps to show the location of all active gas mains and service lines and other information necessary to identify the locations of facilities. (Class II, Priority Action) (P-87-29)

Review emergency procedures to determine if they encompass all response actions expected of employees who could be dispatched to an accident site. (Class II, Priority Action) (P-87-30)

Conduct periodic training and testing in emergency procedures with particular emphasis on those employees hired before 1982. (Class II, Priority Action) (P-87-31)

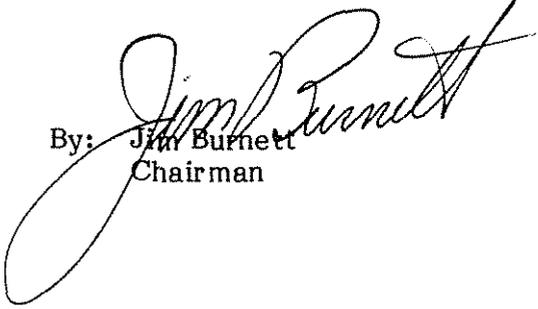
Revise procedures for line locating to provide guidelines for obtaining additional information when system maps are suspected to be inaccurate. (Class II, Priority Action) (P-87-32)

Revise procedures for responding to grade 1 leaks to specify when and who should alert the fire department of an emergency. (Class II, Priority Action) (P-87-33)

The Safety Board also issued Safety Recommendation P-87-34 to the Office of Pipeline Safety, U.S. Department of Transportation.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "... to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations P-87-29 through -33.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in these recommendations.

By: 
Chairman